Attorney Docket Number: FSP0228
Client Reference Number: 232362US
Title: DWDM catv return system with up-converters to prevent fiber crosstalk
Application Number: 09/474,299

Claims

This listing of claims replaces all prior versions and listings of claims in the present application.

Claims 1-41 (Cancelled)

42. (New) An optical apparatus comprising:
at least one optical-to-electrical signal converter configured to convert received optical signals into received electrical signals;
at least one electrical up-converter configured to increase the carrier frequency of received electrical signals into a range where SRS induced crosstalk will be substantially minimized once the up-converted electrical signals are converted back to optical form, multiplexed with other optical signals, and transmitted over an optical fiber, where an amount that the carrier frequency is increased depends on the carrier frequency of the received electrical signals;
at least one electrical-to-optical converter configured to convert the up-converted electrical signals to optical form; and
at least one modulator configured to modulate up-converted electrical signals onto light of different wavelengths and into different frequency bands each less than one octave wide.

43. (New) The optical apparatus of claim 42, wherein the at least one modulator configured to modulate up-converted electrical signals onto light of different wavelengths and into different frequency bands each less than one octave wide further comprises:
at least one modulator configured to modulate up-converted electrical signals onto light of different wavelengths and into different frequency bands each less than one-half of an octave wide.

44. (New) The optical apparatus of claim 42, wherein the at least one electrical up-converter configured to increase the carrier frequency of received electrical signals into a range where SRS induced crosstalk will be substantially minimized once the up-converted electrical signals are converted back to optical form, multiplexed with other optical signals, and transmitted over an optical fiber, where an amount that the carrier frequency is increased depends on the carrier frequency of the received electrical signals, further comprises:
at least one electrical up-converter configured to increase the carrier frequency of received electrical signals by a factor of approximately two when the carrier frequency of the received electrical signals is below 100MHz and the wavelength of the optical signal to which the received electrical signal is converted after up-conversion is between 1220nm and 1360nm, or between 1480nm and 1620nm.

45. (New) The optical apparatus of claim 42, wherein the at least one electrical up-converter configured to increase the carrier frequency of received electrical signals into a range where SRS induced crosstalk will be substantially minimized once the up-converted electrical signals are converted back to optical form, multiplexed with other optical signals, and transmitted over an optical fiber, where an amount that the carrier frequency is increased depends on the carrier frequency of the received electrical signals, further comprises:
at least one electrical up-converter configured to increase the carrier frequency of received electrical signals by a factor of approximately 40 when the carrier frequency of the received electrical signals is approximately between 5 and 65MHz.

46. (New) The optical apparatus of claim 42, further comprising:
a plurality of optical outputs; and

the optical apparatus configured to provide multicarrier modulated optical output signals within a first frequency band on a first optical output and to provide multicarrier modulated optical output signals within a second frequency band on a second optical output.

47. (New) The optical apparatus of claim 46, wherein the optical apparatus configured to provide multicarrier modulated optical output signals within a first frequency band on a first optical output and to provide multicarrier modulated optical output signals within a second frequency band on a second optical output further comprises:
the optical apparatus configured to provide multicarrier modulated optical output signals within a first frequency band of approximately 200-800MHz on a first optical output and to provide multicarrier modulated optical output signals within a second frequency band of approximately 300-1200MHz on a second optical output.

48. (New) The optical apparatus of claim 46, wherein the optical apparatus configured to provide multicarrier modulated optical output signals within a first frequency band on a first optical output and to provide multicarrier modulated optical output signals within a second frequency band on a second optical output further comprises:
the optical apparatus configured to provide multicarrier modulated optical output signals within a first frequency band of approximately 400-600MHz on a first optical output and to provide multicarrier modulated optical output signals within a second frequency band of approximately 600-900MHz on a second optical output.

49. (New) An optical apparatus comprising:
a plurality of receivers to receive a plurality of multicarrier signals;

at least one up-converter configured to upconvert the frequency of carriers in a first received multicarrier signal to a first frequency band, and to upconvert the frequency of carriers in a second received multicarrier signal to a second frequency band, a minimum frequency of any carrier in the second frequency band being at least two times higher than a maximum frequency of any carrier in the first frequency band;

at least one modulator to modulate the carriers of the first and second multicarrier signals with the same information used to modulate the carriers before upconversion; and

a combiner to combine the first and second upconverted multicarrier signals into a single outbound multicarrier signal.

50. (New) The optical apparatus of claim 49, wherein the at least one up-converter configured to upconvert the frequency of carriers in a first received multicarrier signal to a first frequency band, and to upconvert the frequency of carriers in a second received multicarrier signal to a second frequency band, a minimum frequency of any carrier in the second frequency band being at least two times higher than a maximum frequency of any carrier in the first frequency band further comprises:

the upconverter configured to upconvert a first carrier of the first frequency band so that the first carrier, once modulated, occupies a first sub-band of the first frequency band, and to upconvert a second carrier of the first frequency band so that the second carrier, once modulated, occupies a second sub-band of the first frequency band, where the bandwidth of the first sub-band is greater than one octave, and the bandwidth of the second sub-band is less than one octave.

51. (New) The optical apparatus of claim 50, wherein the the upconverter configured to upconvert a first carrier of the first frequency band so that the first carrier, once modulated, occupies a first sub-band of the first frequency band, and to upconvert a second carrier of the first frequency band so that the second carrier, once modulated, occupies a second sub-band of the first frequency band,

where the bandwidth of the first sub-band is greater than one octave, and the bandwidth of the second sub-band is less than one octave further comprises:
the upconverter configured to upconvert a first carrier of the first frequency band so that the first carrier, once modulated, occupies a first sub-band of the first frequency band, and to upconvert a second carrier of the first frequency band so that the second carrier, once modulated, occupies a second sub-band of the first frequency band, where the bandwidth of the first sub-band is greater than three octaves, and the bandwidth of the second sub-band is less than one half of an octave.

52. (New) The optical apparatus of claim 51, wherein the the upconverter configured to upconvert a first carrier of the first frequency band so that the first carrier, once modulated, occupies a first sub-band of the first frequency band, and to upconvert a second carrier of the first frequency band so that the second carrier, once modulated, occupies a second sub-band of the first frequency band, where the bandwidth of the first sub-band is greater than three octaves, and the bandwidth of the second sub-band is less than one half of an octave further comprises:
the upconverter configured to upconvert a first carrier of the first frequency band so that the first carrier, once modulated, occupies a first sub-band of the first frequency band in the range of 5-65MHz, and to upconvert a second carrier of the first frequency band so that the second carrier, once modulated, occupies a second sub-band of the first frequency band in the range of 400-650MHz.

53. (New) The optical apparatus of claim 49, wherein the at least one up-converter configured to upconvert the frequency of carriers in a first received multicarrier signal to a first frequency band, and to upconvert the frequency of carriers in a second received multicarrier signal to a second frequency band, a minimum frequency of any carrier in the second frequency band being at least two times higher than a maximum frequency of any carrier in the first frequency band further comprises:

the upconverter configured to upconvert a first carrier of the first frequency band so that the first carrier, once modulated, occupies a first sub-band of the first frequency band, and to upconvert a second carrier of the first frequency band so that the second carrier, once modulated, occupies a second sub-band of the first frequency band, where a minimum frequency of the first sub-band is more than two times higher than a maximum frequency of the second sub-band.

54. (New) The optical apparatus of claim 49, wherein the at least one up-converter configured to upconvert the frequency of carriers in a first received multicarrier signal to a first frequency band, and to upconvert the frequency of carriers in a second received multicarrier signal to a second frequency band, a minimum frequency of any carrier in the second frequency band being at least two times higher than a maximum frequency of any carrier in the first frequency band further comprises:
the upconverter configured to upconvert a first carrier of the first frequency band so that the first carrier, once modulated, occupies a first sub-band of the first frequency band, and to upconvert a second carrier of the first frequency band so that the second carrier, once modulated, occupies a second sub-band of the first frequency band, where a minimum frequency of the first sub-band is more than six times higher than a maximum frequency of the second sub-band.

55. (New) The optical apparatus of claim 49, wherein the at least one up-converter configured to upconvert the frequency of carriers in a first received multicarrier signal to a first frequency band, and to upconvert the frequency of carriers in a second received multicarrier signal to a second frequency band, a minimum frequency of any carrier in the second frequency band being at least two times higher than a maximum frequency of any carrier in the first frequency band further comprises:
the upconverter configured to upconvert a first carrier of the first frequency band so that the first carrier, once modulated, occupies a first sub-band of the first frequency band, and to upconvert a

second carrier of the first frequency band so that the second carrier, once modulated, occupies a second sub-band of the first frequency band, where the bandwidth of the first sub-band is greater than one octave, and the bandwidth of the second sub-band is less than one half an octave.

56. (New) The optical apparatus of claim 49, wherein the at least one up-converter configured to upconvert the frequency of carriers in a first received multicarrier signal to a first frequency band, and to upconvert the frequency of carriers in a second received multicarrier signal to a second frequency band, a minimum frequency of any carrier in the second frequency band being at least two times higher than a maximum frequency of any carrier in the first frequency band further comprises:
at least one up-converter configured to upconvert the frequency of carriers in a first multicarrier to a first frequency band, and to upconvert the frequency of carriers in a second multicarrier signal to a second band, a minimum frequency of the carriers in the second band being above 200MHz and a maximum carrier frequency of carriers in the first band being below 100MHz.

57. (New) The optical apparatus of claim 49, wherein the at least one up-converter configured to upconvert the frequency of carriers in a first received multicarrier signal to a first frequency band, and to upconvert the frequency of carriers in a second received multicarrier signal to a second frequency band, a minimum frequency of any carrier in the second frequency band being at least two times higher than a maximum frequency of any carrier in the first frequency band further comprises:
at least one up-converter configured to upconvert the frequency of carriers in a first multicarrier to a first frequency band, and to upconvert the frequency of carriers in a second multicarrier signal to a second band, a minimum frequency of the carriers in the second band being above 300MHz and a maximum carrier frequency of carriers in the first band being below 65MHz.